

California Environmental Protection Agency



| Spark-Ignition Marine ~~Vessel~~Watercraft Diurnal Venting Emissions Test
Procedure

TP - 1503

Test Procedure for Determining Diurnal Vented Emissions
from Installed Marine Fuel Tanks

Adopted Date: XXX

DRAFT

TP-1503
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**California Environmental Protection Agency
Air Resources Board**

**Spark-Ignition Marine ~~Vessel~~Watercraft Diurnal Vented Emissions
Test Procedure**

TP-1503

**Test Procedure for Determining Diurnal Vented Emissions
From Installed Marine Fuel Tanks**

A set of definitions common to all Certification and Test Procedures is in Title 13, California Code of Regulations (CCR), section 2752 et seq. These definitions apply to all applicable instances in this test procedure.

For the purpose of this procedure, the term "ARB" refers to the California Air Resources Board, and the term "Executive Officer" refers to the ARB Executive Officer or his or her authorized representative or designate.

1. APPLICABILITY

This Test Procedure, TP-1503, is used to determine the vented emissions from installed marine fuel tanks on spark-ignition marine ~~vessel~~watercrafts. Spark-ignition marine engines are defined in Title 13, California Code of Regulations (CCR), section 2853 et seq. This Test Procedure is proposed pursuant to section 43013 and 43018 of the California Health and Safety Code (CH&SC), and the references cited in section (9) of this document, and is applicable in all cases where spark-ignition marine ~~vessel~~watercrafts are sold, supplied, offered for sale, or manufactured for use in the State of California.

1.1 Requirement to Comply with All Other Applicable Codes and Regulations

Certification or approval of any evaporative emission control system by the Executive Officer does not exempt the engine or evaporative emission control systems from compliance with other applicable codes and regulations such as state and federal safety codes and regulations.

1.2 Safety

This test procedure involves the use of flammable materials and possibly hazardous operations and should only be conducted by, or under the supervision of, those familiar and experienced in the safe use of such materials and operations. Appropriate safety precautions should be observed at all times while performing the tests sequences in this test procedure.

2. PERFORMANCE STANDARDS

The minimum performance standards for certification of evaporative emission control systems on spark-ignition marine ~~vessel~~watercrafts is contained in CCR Title 13, Chapter 9, Article 4, section 2855.

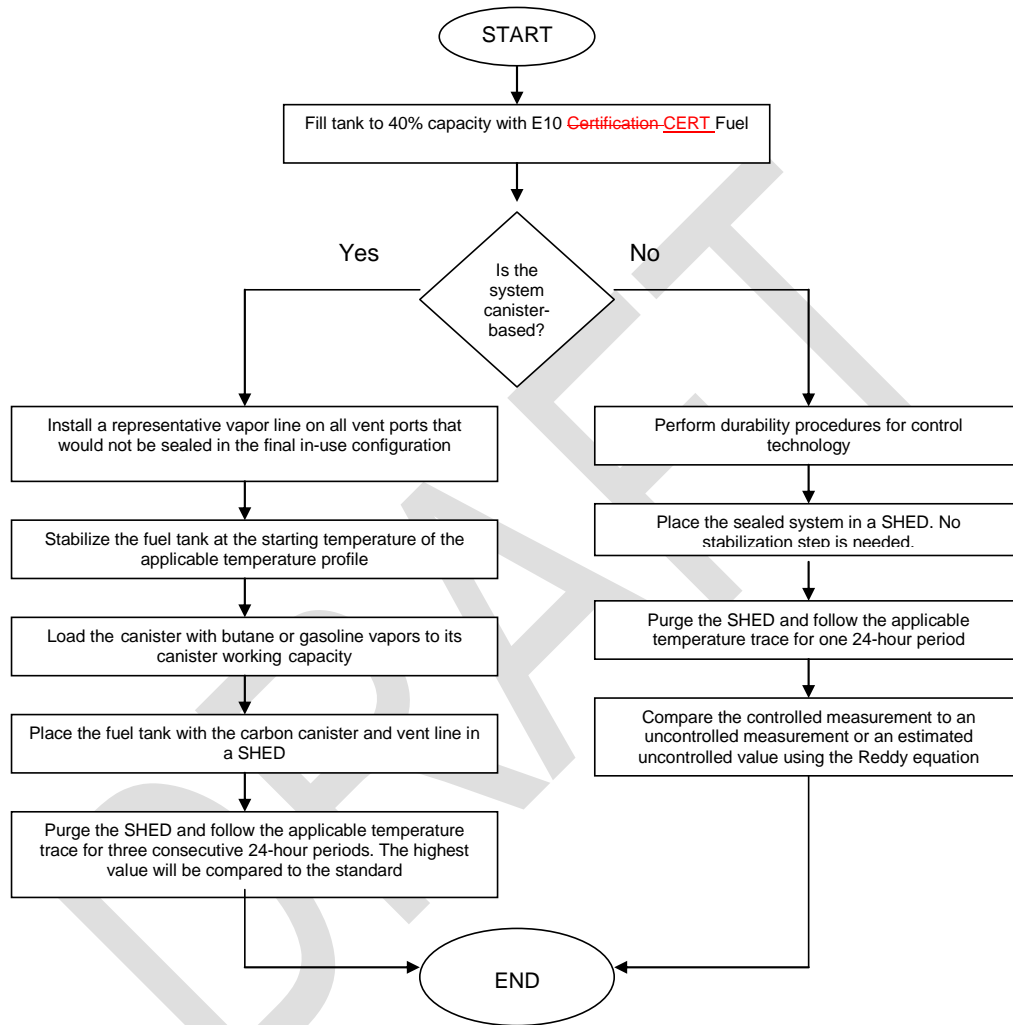
3. GENERAL SUMMARY OF TEST PROCEDURE

A Sealed Housing for Evaporative Determination (SHED) is used to measure diurnal emissions from installed marine fuel tanks. This method subjects installed marine fuel tanks to a fuel temperature profile while maintaining a constant pressure and continuously sampling for hydrocarbons with a Flame Ionization Detector (FID). The calculation of the mass of the diurnal evaporative emissions is as specified in Part III of the "California Evaporative Emission Standards and Test Procedures for 2001 and Subsequent Model Motor Vehicles."

The test sequence is shown graphically in Figure 1. All temperatures monitored during the test are tank fuel temperatures. The fuel tank shall be approximately level during all phases of the test sequence to prevent abnormal fuel distribution.

Testing a representative fuel tank for each evaporative family and comparing the results to the appropriate performance standard determines compliance with requirements of CCR Title 13, Chapter 15, Article 4, section 2855. The three-~~day~~ ~~and one day~~ diurnal test sequence is shown in Figure 1.

Figure 1. Summary of Determination of Diurnal Vented Emissions From Installed Marine Fuel Tanks



4. INSTRUMENTATION

The instrumentation necessary to perform evaporative emission testing for spark-ignition marine ~~vessel~~~~watercrafts~~ is the same instrumentation used for passenger cars and light duty vehicles, and is described in 40 CFR 86.107-96.

4.1 Calibrations

Evaporative emission enclosure calibrations are specified in 40 CFR section 86.117-90,

as incorporated by reference amended with the following subsection:

~~§4.4~~ The diurnal evaporative emission measurement enclosure calibration consists of the following parts: initial and periodic determination of enclosure background emissions, initial determination of enclosure volume, and periodic hydrocarbon (HC) and ethanol retention check and calibration. Calibration for HC and ethanol may be conducted in the same test run or in sequential test runs.

- All test fuels must be tested to ensure they meet ARB specification for E10 CERT fuel. Fuel analysis certification results from a fuel supplier are sufficient ~~to~~ meet this requirement.
- The SHED must be capable of controlling temperature to within the specification of this test procedure while keeping pressure constant.

4.2 Calculation of Hydrocarbon Mass

Calculate the final recovered hydrocarbon mass (M_{HC}) according to 40 CFR section 86.117-96(d)(1), as incorporated by reference.

5. DURABILITY REQUIREMENTS

A durability demonstration is required prior to any testing to determine the performance of a carbon canister or pressure relief valve. These durability tests are designed to ensure that the carbon canister or pressure relief valve remains effective throughout the useful life of the equipment on which it is being used.

5.1 Carbon Canister Durability Requirements.

The Executive Officer shall review the method based on the following requirements:

5.1.1 Maximum Pressure Test

Apply 4.9 psi (34 kPa) of pressure at the tank port with all other ports plugged for a minimum of 60 seconds. Run test at a minimum of 194°F (90°C). At the end of the test, the carbon canister shall meet leak specification as defined in 5.1.2 Leakage Test.

5.1.2 Leakage Test

The carbon canister shall have a maximum allowable leak rate of 1.5 cubic inches (25cc) per minute at 4.9 psi (34 kPa) gauge pressure and when installed shall evidence no leakage when subject to systems pressure test per H-24.18 Systems Test.

5.1.3 Flow Restriction

The allowable air tube pressure drop across the carbon canister shall be less than 0.145 psi (1.0 kPa) at 60 SLPM (Standard Liters Per Minute) air flow for canisters that vent refueling vapors, or 0.508 psi (3.5 kPa) at 60 SLPM air flow for canisters that do not vent refueling vapors.

5.1.4 Canister Connection Strength Test

The canister ports shall have sufficient strength to withstand a minimum load of 50 lbs. (22.7 kg). Pull the connection in its most vulnerable direction at a 90° angle to the

connection opening at a rate of 1 inch per minute until the port breaks. The load shall be greater than 50 lbs. (22.7 kg).

NOTE: Female threaded ports shall have a barb or intended fitting installed to perform this test.

5.1.5 Fire Resistance Test

Canisters intended to be mounted inside an engine compartment, shall be capable of withstanding a 2-1/2 minute exposure to free burning fuel (N-Heptane) as required by Title 33 CFR, Section 183.590, and in ABYC H-24, Gasoline Fuel Systems. Canister shall be tested void of liquid and or fuel vapor. After the canister returns to ambient temperature, the canister sample shall be examined, and pressure checked with 1/4 psi (1.8 kPa) of aerostatic pressure. Pressure shall be applied gradually by means of a suitable regulator so as not to strain the canister due to pressure surge, and maintained at test pressure for a minimum of five minutes. The canister fails the test if leakage is detected in the canister using a means other than the pressure drop method.

5.1.6 Thermal Cycle Test

Canisters shall meet leakage and flow restriction requirements of 5.1.2 and 5.1.3 after being exposed to 40 temperature cycles as follows:

- (1) 1 hour at -40°F (-40°C)
- (2) 1 hour transition
- (3) 1 hour at 176°F (80°C)
- (4) 1 hour transition

5.1.7 Corrosion Resistance

Salt Fog - External metallic parts of the canister shall be tested to 168 hours of Salt Fog per ASTM B117. These parts shall not exhibit any functional material degradation or deterioration. Components required for installation and hose connection must be installed for testing.

5.1.8 Humidity and Vibration

Humidity Preconditioning - Canisters are to be soaked at 95°F (35°C) and 80 percent relative humidity for a period of 72 hours. Canisters are to have no vacuum applied during this test and all of the ports are to be capped.

EXCEPTION: Humidity preconditioning is not required for non-hygroscopic materials.

5.1.9 Vibration - Following the Humidity Preconditioning, canisters shall meet the performance requirements of C-2.9.10.7 when exposed to random vibration, rough water shock, and towing shock. Rigidly mount the canister to the shaker table using the canister mounting provisions.

- (1) Random Vibration - Table 2.1 contains the random vibration profiles. Each profile shall be run for a duration of 20 hours for a total of 60 hours to completely test the durability of the component. Testing shall occur with a temperature profile transposed over the test time per axis test. The temperature profile shall be a dwell of 0.5 hours at -40°F (-40°C), transition consistently from -40°F (-40°C) to 176°F (80°C) in 4.5 hours, and then dwell at 176°F (80°C) for 1 hour. This profile can be

run in either direction. All vibration shall occur at 75°F ± 5° (23°C ± 2.5°). A vacuum shall be drawn on the vapor inlet port sufficient to maintain 5 SLPM flow throughout the entire vibration test. The flow out of the vapor inlet shall be filtered to capture any carbon that leaves the canister. The maximum carbon particle size lost shall not exceed 500 microns

(2) Rough Water Shock - Apply 2250 half-sine shock pulses with a 15g amplitude and a duration of 12 milliseconds in the vertical direction. In addition, apply 250 half-sine shock pulses with a 22g amplitude and a duration of 14 milliseconds in the vertical direction.

(3) Towing Shock - Apply 1125 half-sine shock pulses with a 15g amplitude and a duration of 6 milliseconds in the vertical direction. Canisters shall not permit particles greater than 500 microns to migrate out of any canister port, under any condition. Pressure drop across canister after completion of vibration and shock tests shall not increase by more than 0.0725 psi (0.5 kPa) from virgin samples at 60 SLPM. The carbon canister mounting and bracketry shall be validated using the application specific vibration profile. If the profile is unavailable, use the profile in Table 2.1. Hoses shall be installed and supported per canister manufacturer's specification. Fill the canister with water equivalent to the carbon heel to simulate worst case mounting load. Run the vibration test above without flow to the canister or tubes capped.

Table 2.1—Random Vibration Profiles

Longitudinal		Lateral		Vertical	
Freq Hz	Level (g ² /Hz)	Freq Hz	Level (g ² /Hz)	Freq Hz	Level (g ² /Hz)
10	0.0021	10	0.0011	10	0.0031
14	0.0022	12	0.0027	12	0.0045
18	0.0010	18	0.0006	18	0.0022
26	0.0055	24	0.0066	26	0.0150
52	0.0027	32	0.0009	34	0.0029
60	0.0009	38	0.0061	38	0.0205
76	0.0079	46	0.0072	50	0.0078
92	0.0022	58	0.0010	58	0.0023
114	0.0206	76	0.1035	74	0.0120
150	0.1538	150	0.0348	92	0.0056
170	0.0043	194	0.0053	114	0.0656
260	0.0463	278	0.2060	150	0.1025
302	0.0286	332	0.0073	188	0.0063
376	0.4968	374	0.0044	260	0.4648
414	0.0793	452	0.0176	330	0.0241
490	0.0425	676	0.0175	376	0.0328
526	0.0051	748	0.1920	414	0.0027
602	0.0542	792	0.0310	570	0.0081
680	0.0366	976	0.0090	602	0.0588
750	0.2925	1052	0.0510	680	0.0252
790	0.0124	1090	0.0042	792	0.0014
902	0.0349	2000	0.0042	902	0.0178
940	0.0024	Grms =	6.12	976	0.0055
1050	0.0572			1050	0.0361
1350	0.0027			1660	0.0015
1500	0.0409			2000	0.0015
1540	0.0016			Grms = 6.34	
2000	0.0005				
Grms = 7.98					

5.1.10 Carbon Performance - A maximum loss of 12% or less of total working capacity is required following 150 load/purge cycles as well as preconditioning and purge with warm (25+/-5 C) room air with ambient relative humidity. A common cycle is measuring the change in working capacity according to 40 CFR §1060.240(e)(2)(i), doing the load/purge using 150 cycles of load with a mixture of 50% gasoline vapor/air loaded at 40 grams/hr and purged each time with 300 bed volumes of room air at 22.7 liters/minute. Finally, the canister working capacity must be recalculated following 40 CFR §1060.240(e)(2)(i). The maximum loss must be 12% or less of total working capacity.

5.2 Pressure Relief Valve Durability and Reliability Requirements.

The Executive Officer shall review the method based on the following requirements:

The pressure relieve valve durability and reliability requirements may be performed on a sealed fuel tank only or a sealed fuel system. All testing temperatures must be within $\pm 2.5^{\circ}\text{C}$ of the required temperature.

5.2.1 Thermal cycle test:

The pressure relief valve is placed in an environment where they are subjected to temperature changes for one cycle as indicated herein: 80°C , 15.5 hours followed by 25°C , 0.5 hours followed by -40°C , 7.5 hours followed by 25°C , 0.5 hours followed by 50°C , 95% \pm 2% humidity, 15.5 hours followed by 25°C , 0.5 hours followed by -40°C , 7.5 hours and followed by 25°C , 0.5 hours. Up to 5 minutes is allowed for the temperature to rise and stabilize. When not specified, the humidity is ambient. Total ten (10) cycles are required.

5.2.2 Pressure/Vacuum Test:

The Pressure/Vacuum test is performed under both high (80°C) and low (-40°C) temperature. Determine the pressure relief valve's design pressure limit (must be at least 7.35 kPa) under normal operating conditions. Connect the pressure relief valve (valve) to a sealed empty tank. Pressurize the empty tank until the valve opens and then evacuate to -2.94 kPa. Flow rates must be no less than 1 L/min. The pressure/vacuum cycling shall be performed at $80^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ambient with compressed air of no less than 30°C and at $-40^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ambient with compressed air of no higher than 10°C . Repeat the pressure/vacuum process until the valve has been subjected to not less than 8300 cycles in each temperature condition.

5.2.3 Vibration Test:

The vibration test is performed with a vibration frequency of 11 Hz at an acceleration of 59.8 m/s^2 . The valve must be subjected to continuous sinusoidal vibration in it's vertical and horizontal (radial and axial) direction for 10^6 times each.

5.2.4 Dust Test:

The dust test is performed in a test room filled by dust indicated by JIS (Japanese Industrial Standards) Z8901 with a concentration of 30 g/m^3 . The valve is pressured to open and then close when the tank is evacuated to a maximum of -2.94 kPa \pm 0.1kPa . Three hundred (300) pressure/vacuum cycles are required.

5.2.5 Ozone Test

The ozone test is a static test performed in an environment that can produce ozone to the specified level and temperature. The pressure relief valve must be subjected to a continuous exposure of 150 ppb \pm 5 ppb (parts per billion) of ozone at 30°C for 120 hours.

(a) This test procedure measures diurnal emissions from installed marine fuel tanks. The basic process is as follows:

- (1) Diurnal measurements are based on ~~a~~ representative temperature cycles ~~s~~ as follows:
- (i) Diurnal fuel temperatures for marine fuel tanks that will be installed in nontrailerable boats must undergo repeat temperature swings of 2.6°C between nominal values of 27.6 and 30.2°C.
 - (ii) Diurnal fuel temperatures for other installed marine fuel tanks must undergo repeat temperature swings of 6.6°C between nominal values of 25.6 and 32.2°C. For marine fuel tanks, the temperature cycle specifies fuel temperatures rather than ambient temperatures. Fuel tank temperatures must be within ±2.5°C of the temperature cycle. The applicable temperature cycles are indicated in the following tables:

Table 3.1–Fuel Temperature Profile for Installed Marine Fuel Tanks in Trailerable Boats

Hour	0	1	2	3	4	5	6	7	7.5	8	9	10	11
(°C)	25.6	25.7	26.5	27.9	29.2	30.4	31.4	32.0	32.2	32.2	32.2	32.1	31.7
Hour	12	13	14	15	16	17	18	19	20	21	22	23	24
(°C)	31.0	30.2	29.3	28.6	28.0	27.5	27.0	26.6	26.3	26.1	25.9	25.7	25.6

Table 3.2–Fuel Temperature Profile for Installed Marine Fuel Tanks in Non-Trailerable Boats

Hour	0	1	2	3	4	5	6	7	7.5	8	9	10	11
(°C)	27.6	27.7	27.9	28.5	29.0	29.5	29.9	30.1	30.2	30.2	30.2	30.2	30.0
Hour	12	13	14	15	16	17	18	19	20	21	22	23	24
(°C)	29.7	29.4	29.1	28.8	28.5	28.3	28.1	28.0	27.9	27.8	27.7	27.6	27.6

(2) Fill the fuel tank to 40 percent of nominal capacity with E10 ~~CERT~~ certification Fuel.

(3) Install a vapor line from ports that would vent to atmosphere in the final in-use configuration. Use a length of vapor line representing the largest inside diameter and shortest length that would be expected for in-use installations of that tank.

(4) Stabilize the fuel tank ~~at the to be within 2.0 °C of the nominal~~ starting temperature ~~of the applicable temperature profile from specified in (1) above. Install a thermocouple meeting the requirements of 40 CFR 86.107-96(e) in the approximate mid-volume of fuel and record the temperature at the end of the stabilization period to the nearest 0.1°C.~~ For sealed fuel systems, do not seal the system until the fuel reaches equilibrium at the appropriate starting temperature.

(5) If the fuel tank is equipped with a carbon canister, the carbon canister must meet the durability requirements of section 5 before testing. Load the canister with butane or gasoline vapors to its *canister working capacity* as specified in 40 CFR §1060.240(e)(2)(i) and attach it to the fuel tank in a way that represents a typical in-use configuration. The canister is only certified for use on tanks of equal or lesser volume to the test tank used for certification

- (6) Prepare the tank for mass measurement using one of the following procedures:
- (i) Place the stabilized fuel tank with the carbon canister and vent line in a SHED meeting the specifications of 40 CFR 86.107–96(a)(1) that is equipped with a FID analyzer meeting the specifications of 40 CFR 1065.260. Take the following steps in sequence:
 - (A) Purge the SHED.
 - (B) Close and seal the SHED.
 - (C) Zero and span the FID analyzer.
 - (D) Within ten minutes of sealing the SHED, measure the initial hydrocarbon concentration. This is the start of the sampling period.
 - (ii) If your testing configuration involves mass emissions at the standard of 2 grams or more, you may alternatively place the stabilized fuel tank in any temperature-controlled environment and establish mass emissions as a weight loss relative to a reference fuel tank using the procedure specified in §1060.520(d) instead of calculating it from changing hydrocarbon concentrations in the SHED. Follow the applicable temperature trace from Table 3.1 or 3.2 of this procedure for a 24-hour period. You need not measure emissions during this stabilization step.
- (7) As soon as possible after conducting the stabilization profile in paragraph (6) of this section, purge the SHED and Control Temperatures as follows:
- (i) Supply heat to the fuel tank for continuously increasing temperatures such that the fuel reaches the maximum temperature in approximately eight hours. Set the target temperature by adding the temperature swing specified in paragraph (a)(1) of this section to the recorded starting temperature. Hold the tank for approximately 60 minutes at a temperature no less than 0.1°C below the target temperature. For example, if the recorded starting fuel temperature for a fuel tank that will be installed in a nontrailerable vessel is 27.1°C, the target temperature is 29.7°C and the fuel must be stabilized for 60 minutes with fuel temperatures not falling below 29.6°C. For EPA testing, fuel temperatures may not go 1.0°C above the target temperature at any point during the heating or stabilization sequence. Measure the hydrocarbon concentration in the SHED at the end of the high-temperature stabilization period. Calculate the diurnal emissions for this heating period based on the change in hydrocarbon concentration over this sampling period as measured by the FID analyzer. Allow the fuel temperature to cool sufficiently to stabilize again at the starting temperature without emission sampling. Repeat the heating and measurement sequence for three consecutive days, starting each heating cycle no more than 26 hours after the previous start.
 - (ii) Follow the applicable temperature trace from paragraph (1) of this procedure for three consecutive 24-hour periods. Start measuring emissions when you start the temperature profile. The end of the first, second, and third emission sampling periods must occur at 1440 ± 6, 2880 ± 6, and 4320 ± 6 minutes respectively, after starting the measurement procedure. Use the highest of the three 24-hour emission sampling periods to determine whether your fuel tank meets the diurnal emission standard.
- (8) For emission control technologies that rely on a sealed fuel system utilizing a Pressure Relief Valve (PRV), you may omit the stabilization step in paragraph (6) of this procedure and the last two 24-hour periods of emission measurements in paragraph (7) of this procedure. The PRV must meet the durability requirements of Table 3.3 Pressure Relief Valve Durability and Reliability section 5 prior to conducting the SHED test. Purge the SHED and follow the applicable temperature trace from paragraph (1) of this procedure for one 24-hour period. The end of this 24-hour sampling period must occur at 1440 ± 6 minutes. This 24-hour sampling period emissions must meet the venting control efficiency standard of

65%. To determine the venting control efficiency, a venting control test must be conducted according to TP-1503 with E10 ~~Certification-CERT~~ Fuel and then compared to the average emission value derived from the Diurnal SHED test results. As an alternative, an estimated uncontrolled venting value derived from the fuel tank vapor generation equation in SAE Technical Paper 892089, *Prediction of Fuel Vapor Generation From a Vehicle Fuel Tank as a function of Fuel RVP and Temperature* (Reddy, 1989) can be compared to the Diurnal SHED test results.

(b) You may subtract your fuel tank's permeation emissions from the measured diurnal emissions. For the purpose of this test procedure, permeation emissions must be measured as specified in TP-1504 using the same test fuel as used in TP-1503 and conducted at $28 \pm 2^\circ\text{C}$. Use appropriate units and corrections to subtract the permeation emissions from the fuel tank during the diurnal emission test. You may not subtract a greater mass of emissions under this paragraph (b) than the fuel tank would emit based on meeting the applicable emission standard for permeation.

~~Table 3-3—Pressure Relief Valve Durability and Reliability Requirements The Executive Officer shall review the method based on the following requirements:~~

~~The pressure relieve valve durability and reliability requirements may be performed on a sealed fuel tank only or a sealed fuel system. All testing temperatures must be within $\pm 2.5^\circ\text{C}$ of the required temperature.~~

~~(a) — Thermal cycle test:~~

~~The pressure relief valve is placed in an environment where they are subjected to temperature changes for one cycle as indicated herein: 80°C , 15.5 hours followed by 25°C , 0.5 hours followed by 40°C , 7.5 hours followed by 25°C , 0.5 hours followed by 50°C , 95% \pm 2% humidity, 15.5 hours followed by 25°C , 0.5 hours followed by 40°C , 7.5 hours and followed by 25°C , 0.5 hours. Up to 5 minutes is allowed for the temperature to rise and stabilize. When not specified, the humidity is ambient. Total ten (10) cycles are required.~~

~~(b) — Pressure/Vacuum Test:~~

~~The Pressure/Vacuum test is performed under both high (80°C) and low (-40°C) temperature. Determine the pressure relief valve's design pressure limit (must be at least 7.35 kPa) under normal operating conditions. Connect the pressure relief valve (valve) to a sealed empty tank. Pressurize the empty tank until the valve opens and then evacuate to 2.94 kPa. Flow rates must be no less than 1 L/min. The pressure/vacuum cycling shall be performed at $80^\circ\text{C} \pm 3^\circ\text{C}$ ambient with compressed air of no less than 30°C and at $-40^\circ\text{C} \pm 3^\circ\text{C}$ ambient with compressed air of no higher than 10°C . Repeat the pressure/vacuum process until the valve has been subjected to not less than 8300 cycles in each temperature condition.~~

~~(c) — Vibration Test:~~

~~The vibration test is performed with a vibration frequency of 11 Hz at an acceleration of 59.8 m/s^2 . The valve must be subjected to continuous sinusoidal vibration in its vertical and horizontal (radial and axial) direction for 10^6 times each.~~

(d) ~~Dust Test:~~

~~The dust test is performed in a test room filled by dust indicated by JIS (Japanese Industrial Standards) Z8901 type 15 with a concentration of 30 g/m³. The valve is pressured to open and then close when the tank is evacuated to a maximum of 2.94 kPa +/- 0.1kPa. Three hundred (300) pressure/vacuum cycles are required.~~

(e) ~~Ozone Test~~

~~The ozone test is a static test performed in an environment that can produce ozone to the specified level and temperature. The pressure relief valve must be subjected to a continuous exposure of 150 ppb +/- 5 ppb (parts per billion) of ozone at 30°C for 120 hours.~~

6. TEST FUEL

~~E10 CERT Fuel is California certification gasoline as specified in "California 2015 and Subsequent Model Criteria Pollutant Exhaust Emission Standards and Test Procedures and 2017 and Subsequent Model Greenhouse Gas Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" Section II.A.100.3.1.2 as adopted March 22, 2012, as incorporated by reference herein. E10 Certification Fuel: defined as the interim E10 CERT fuel until the adoption date of a California E10 certification fuel. The interim E10 certification fuel can continue to be used until one year after the adoption of a Californian E10 certification fuel.~~

~~Table 6.1 Interim E10 Fuel Specifications~~

Fuel Property	Limit	Test Method
Octane (R+M)/2 (min)	91	D2699-88, D-2700-88
Sensitivity (min)	7.5	D-2699-88, D-2700-88
Lead, g/gal (max) (No lead added)	0-0.04	Title 13-CCR §2253.4(c)
Distillation Range-°F 50 pct. point 90 pct. point		Title 13-CCR §2263
EP, maximum	300	

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Residue, vol% (max)	2.0	
Sulfur, ppm by wt	8-14	Title 13 CCR §2263
Phosphorous, g/gal (max)	0.005	Title 13 CCR §2253.4(c)
RVP, psi	6.9-	Title 13 CCR §2263
Olefins, vol %	4.0-	Title 13 CCR §2263
Total Aromatic Hydrocarbons, vol%	20-22	Title 13 CCR §2263
Benzene, vol %	0.6-	Title 13 CCR §2263
Methyl tertiary-butyl ether, vol % (max)	0.05	Title 13 CCR §2263
Ethanol, vol %	9.8-	
Additives: Sufficient to meet requirements of Title 13, CCR §2257		
Copper Corrosion	No. 1	D-130-88
Gum, Washed, mg/100 ml (max)	3.0	D-381-86
Oxidation Stability, minutes (min)	1000	D-625-88
Specific Gravity	Report	
Heat of Combustion	Report	
Carbon, wt%	Report	
Hydrogen, wt%	Report	

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7. ALTERNATIVE TEST PROCEDURES

Test procedures, other than specified above, shall only be used if prior written approval is obtained from ARB's Executive Officer. In order to secure the Executive Officer's approval of an alternative test procedure, the applicant is responsible for demonstrating to the Executive Officer's satisfaction that the alternative test procedure is equivalent to this test procedure.

8. REFERENCES

1. California Evaporative Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles, California Environmental Protection Agency, Air Resources Board, El Monte, CA, 2000.
2. California Exhaust Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles, California

Environmental Protection Agency, Air Resources Board, El Monte, CA, 2002.

3. Control of Emissions from New and In-use Highway Vehicles and Engines, Code of Federal Regulations, Title 40, Part 86, 1995.
4. SAE Technical Paper 892089, Prediction of Fuel Vapor Generation From a Vehicle Fuel Tank as a function of Fuel RVP and Temperature (Reddy, 1989).

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